The Physics capabilities of the ALICE Forward Multiplicity Detector (FMD)

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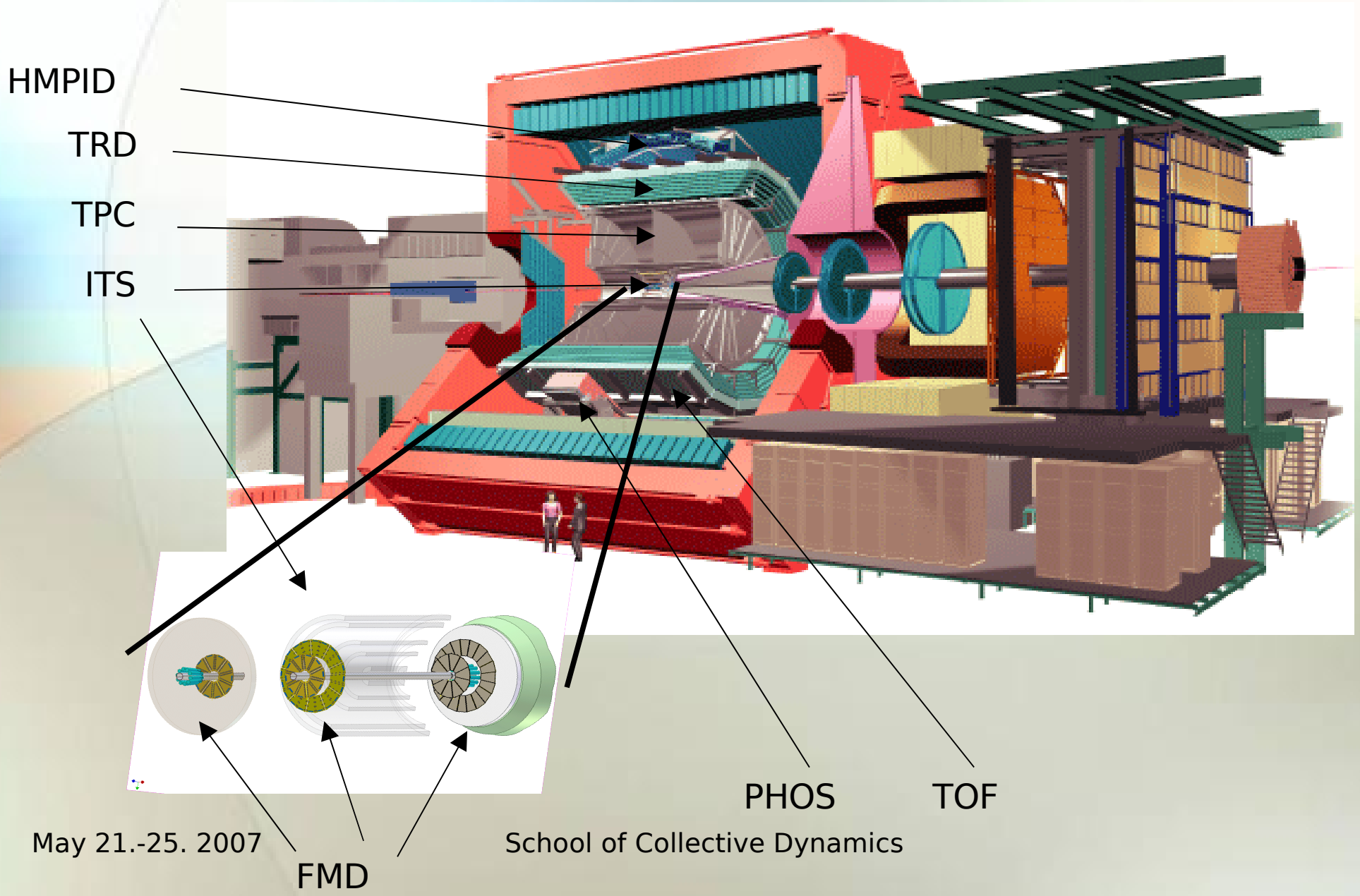
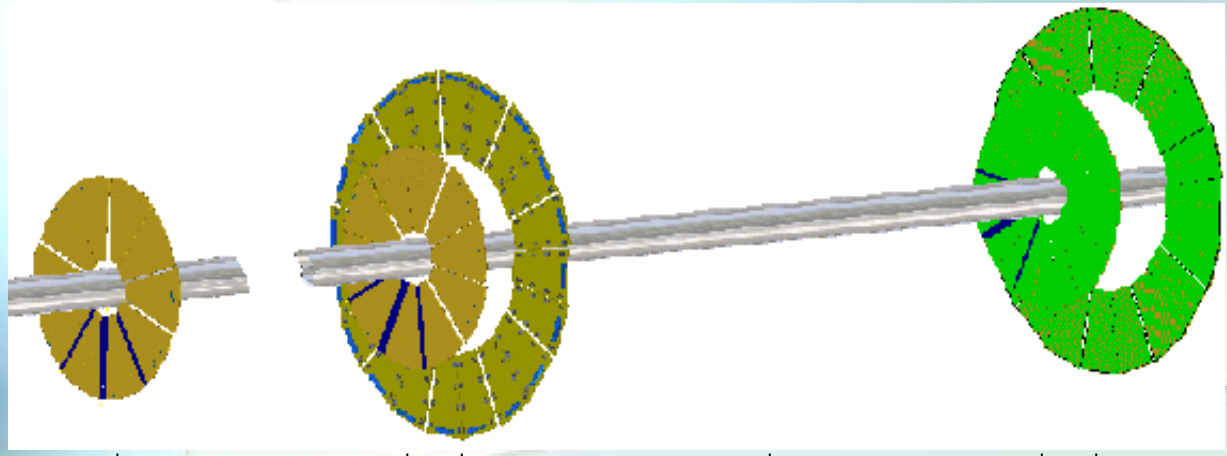
Outline

- Overview of ALICE and the FMD.
- The tasks of the FMD in ALICE.
- Multiplicity, event plane and flow.
- Data Analysis.
- Conclusion.

The ALICE experiment



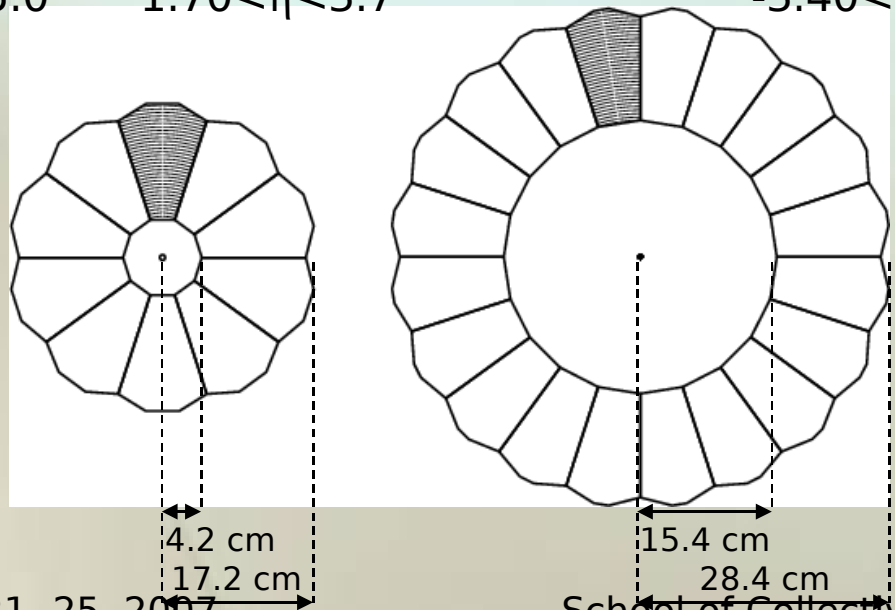
Sketch of the FMD



320 cm 83.4 cm 75.2 cm 0 cm -75.2 cm -83.4 cm

3.7<η<5.0 1.70<η<3.7 -3.40<η<-1.70

Exploded view of the FMD system. Each ring contains 10240 silicon strips.



Detailed view of an inner and an outer ring. The inner rings have 512 strips in 20 sectors and the outer rings have 256 strips in 40 sectors.

Specifications of the FMD

- The Forward Multiplicity Detector consists of 51200 silicon strips for detection of charged particles.
- Rapidity coverage:
  - FMD 3: $-3.4<\eta<-1.7$
  - FMD 1+2 : $1.7<\eta<5.0$
- Full azimuthal coverage within the above rapidity windows.
- Signal/noise= 20 - 40.

Tasks of the FMD

- Measure the charged particle multiplicity.
- Measure the event plane.
- Measure the flow.
- Obtain centrality.

Multiplicity

- The Charged Particle Multiplicity, $dN/d\eta$ is probably the most basic observable in Heavy Ion Physics.
- As it is dependent on initial conditions it can be used to estimate the initial, and if the evolution of the fireball is considered adiabatic, final entropy.
- The multiplicity enters many calculations of other quantities.

Event Plane and Flow I

- Particle yields can be written as a Fourier expansion in the azimuthal angle, ϕ:

$$E\frac{d^3N}{d^3p}=\frac{1}{2\pi}\frac{d^2N}{p_T dp_T dy}\left(1+\sum_{n=1}^{\infty}2v_n\cos(n(\phi-\Psi_r))\right)$$

- Here, v_n are the harmonics of the flow; v_1 is the directed flow and v_2 is the elliptical flow.
- Ψ_r is the reaction plane angle. The FMD can measure the event plane angle.

Event Plane and Flow II

- The event plane angle is determined using the formula:

$$\Psi_r = \frac{1}{n}\left(\tan^{-1}\frac{\sum_i w_i \sin(n\phi_i)}{\sum_i w_i \cos(n\phi_i)}\right)$$

- With the event plane, the coefficients of the Fourier expansion are found from:

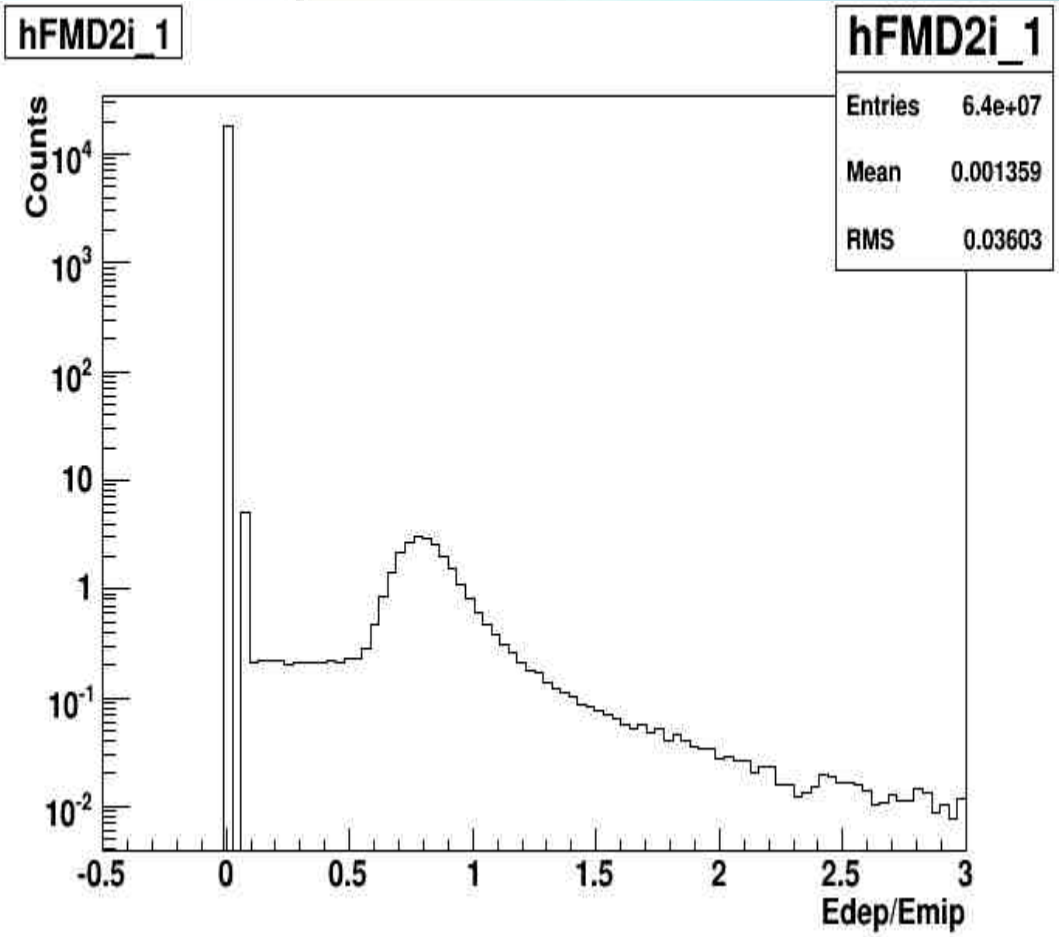
$$v_n = \left\langle \cos(n(\phi - \Psi_r)) \right\rangle$$

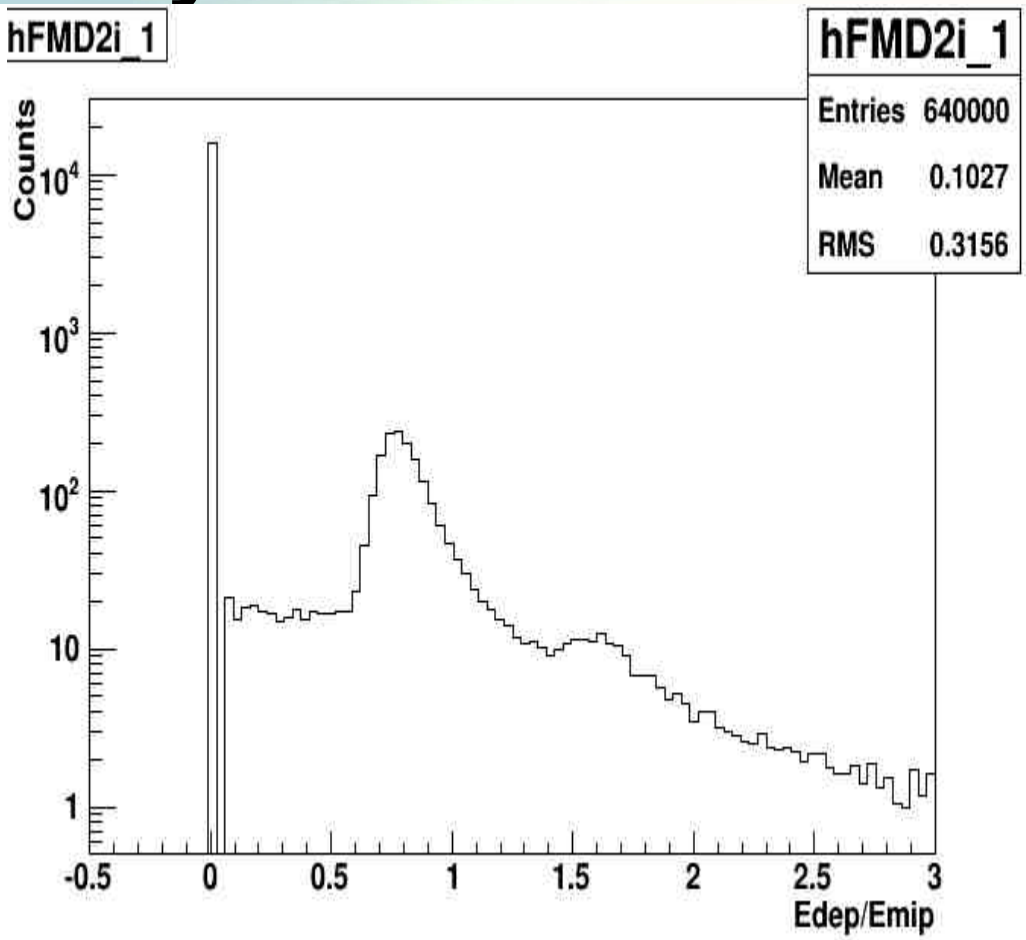
- The event plane resolution is determined using the subevent method.

Simulations

- PYTHIA 6 used to generate pp collisions at $s^{0.5} = 14$ TeV
- HIJING used to generate PbPb collisions at $(s_{NN})^{0.5} = 5.5$ TeV
- To generate flow in PbPb collisions the afterburner developed by J. Radomski was used to modify HIJING events.

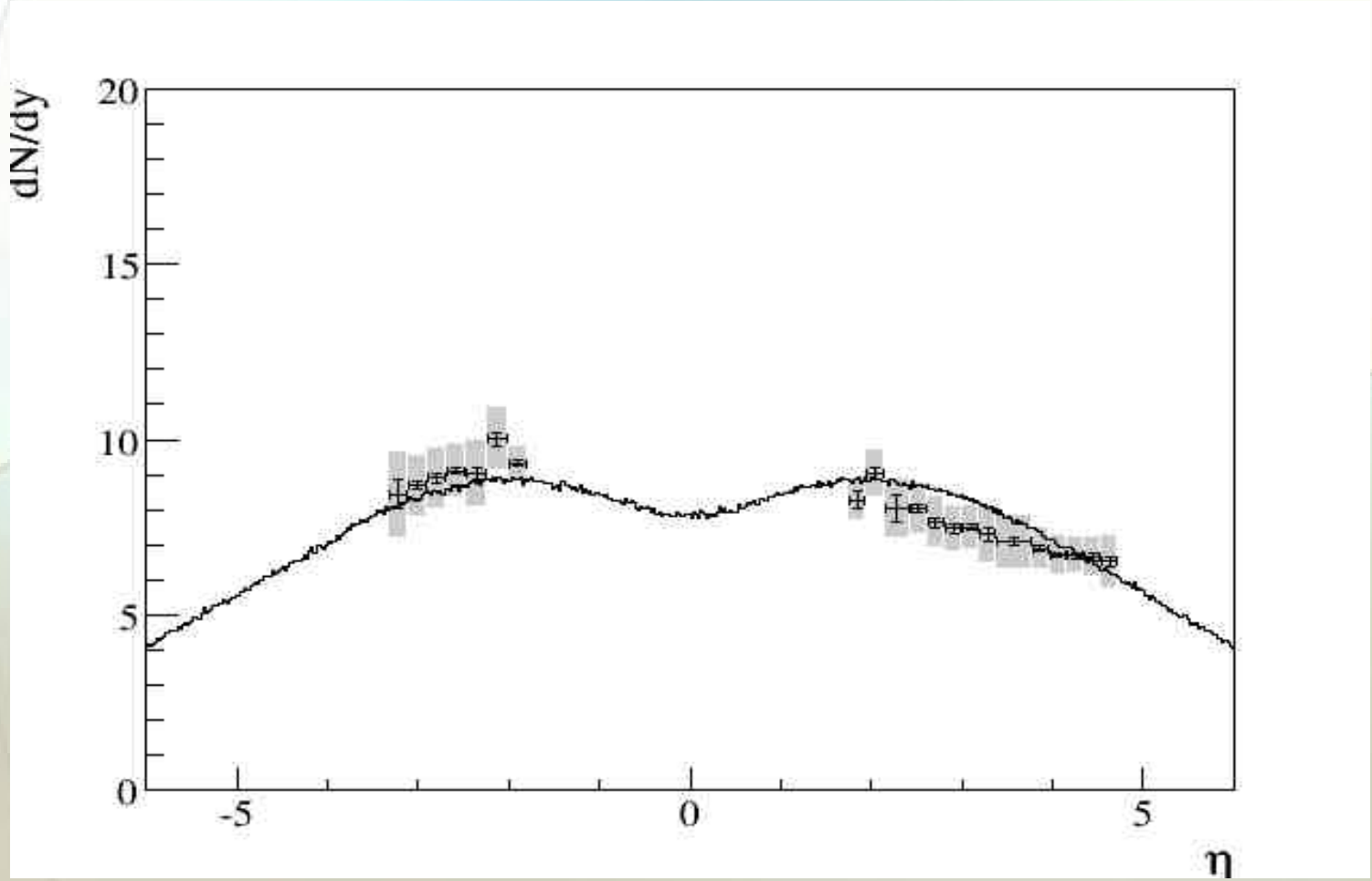
Data Analysis





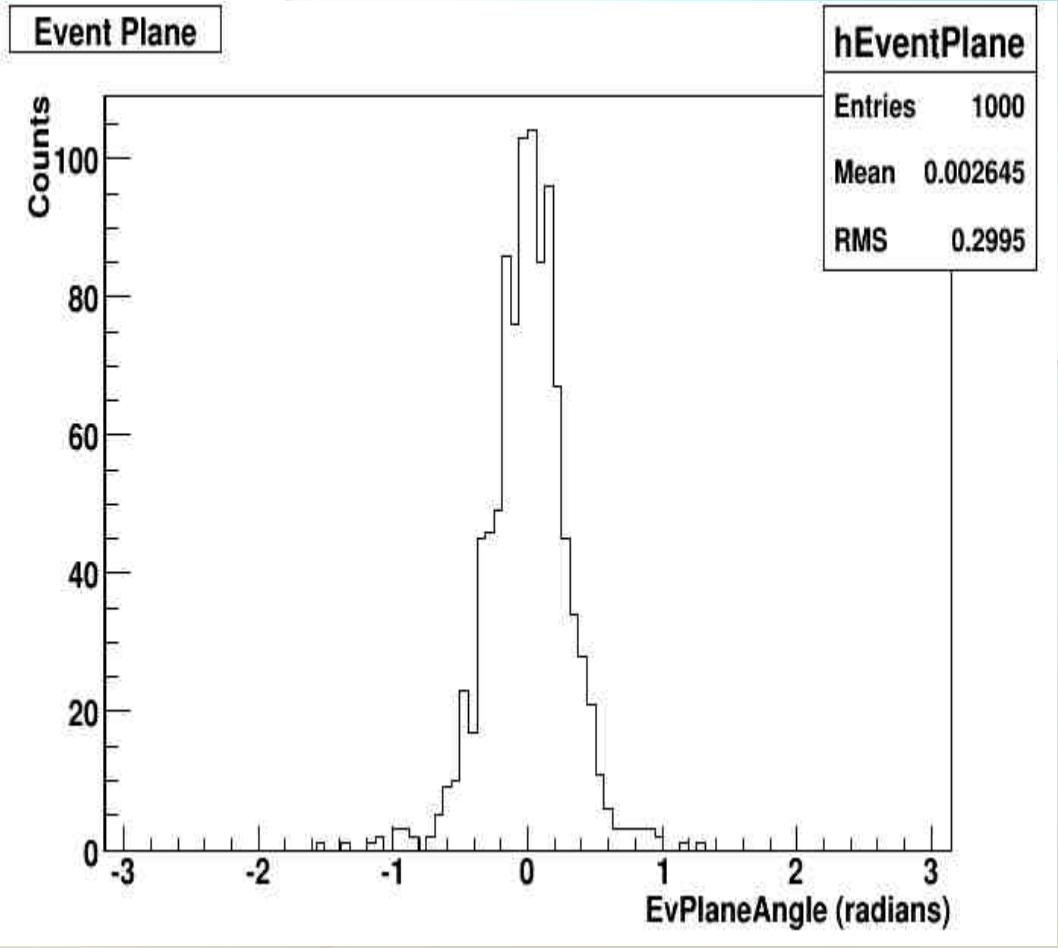
Left panel shows distribution of deposited energies pr. event in the FMD for pp collisions at 14 TeV. The Landau peak is clearly visible. Right panel shows same distribution for Pb+Pb coliisions at 5.5 TeV, with a second Landau peak visible for 2 MIPs.

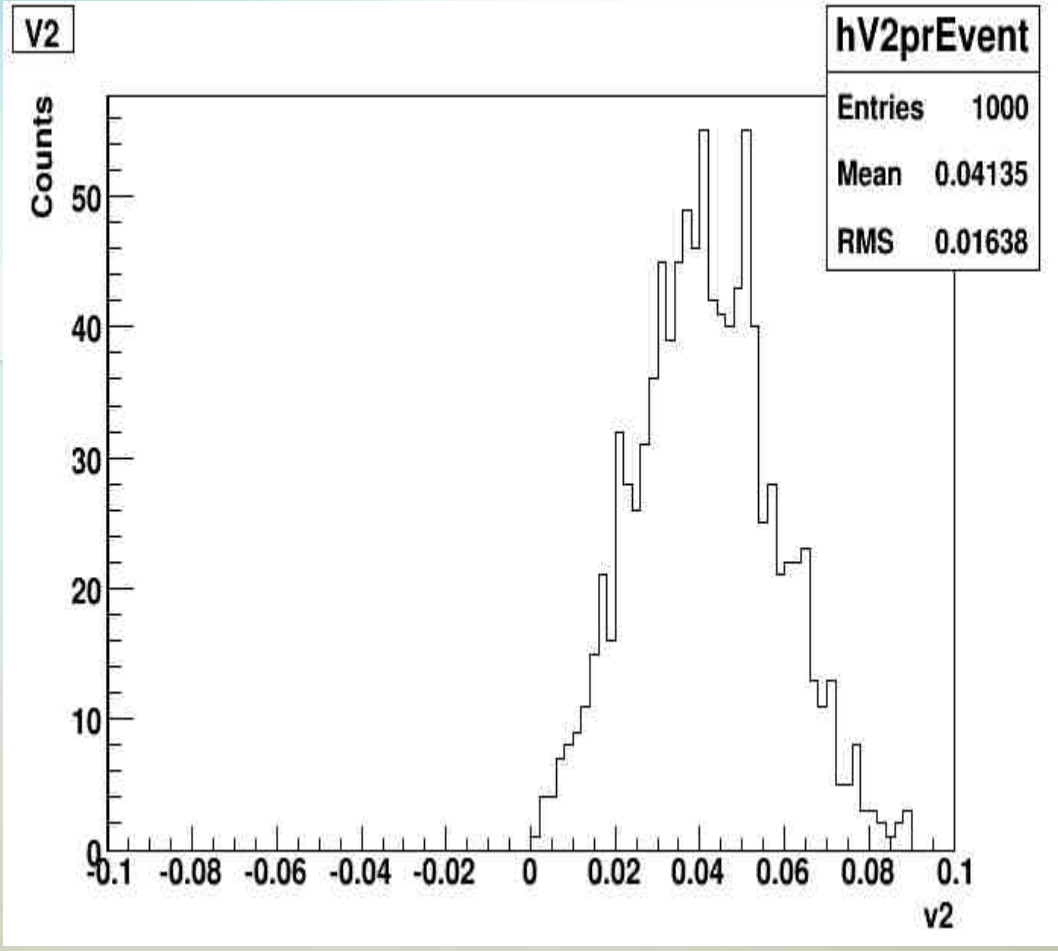
Results: Multiplicity



Reconstruction of 100000 14 TeV pp events. Boxes indicate systematic errors. Full drawn curve is the input multiplicity from PYTHIA.

Results: Event Plane and Flow





Right plot shows reconstruction of the second order event plane in 1000 PbPb events with the event plane set to zero. Left plot shows reconstruction of v_2 in the same 1000 events in which v_2 was set to 0.05.

Conclusions

- The FMD can measure the charged particle multiplicity, the event plane and the flow (with non-optimal weights) in its pseudorapidity acceptance.
- The present analysis shows promising results in performing the measurements with good precision.